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Foreign funding to an emerging market: the Monetary Premium Theory and the Brazilian Case, 1991 – 1998

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Abstract

We develop a framework to explain the private capital flows between the rest of the world and an emerging economy. The model, based on the monetary premium theory, relates an endogenous supply of foreign capitals to an endogenous differential of interest rates; its estimation uses the econometric techniques initiated by Heckman. Four questions regarding the capital flows phenomenon are explored, including the statistical process that governs the events of default and the impact of the probability of default on the interest rate differential. Using the methodology, we analyse the dynamics of foreign capital movements in Brazil during the 1991-1998 period.

JEL classification: F21, F32

Keywords: capital flows, default probability, interest rate differential, international lenders, sample selection model.

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1. Introduction

This paper deals with the relations between capital flows and the interest rate differential. We develop, and estimate for an important emerging market – Brazil, a model that relates the supply of foreign capitals to an endogenous differential of interest rates and a few exogenous indicators. In the presence of frictions, the international interest rate loses importance as a reference for investment decisions; subjective rates, reflecting individual assessments of possible losses, provide the guidelines. Before investigating the links between capital flows and interest rate differentials, it is then necessary to examine the subjective interest rate building mechanism and, especially, its relation to the probability of default. Modelling the mechanisms that govern the probability of default must then come first.

The following four points are examined:

- (1) What is the relation among capital flows, the subjective interest rate differential and other variables?
- (2) What is the subjective interest rate differential building mechanism?
- (3) What are the determinants of the probability of default?
- (4) What is the process governing the realisation of default events?

The above questions have been the object of extensive research. Eichengreen and Portes (1986), as well as Cardoso and Goldfajn (1997), focus on the relation between the interest differential and capital flows – question (1); Eichengreen and Mody (1998, 1999) dwell on questions (2) and (3); Min (1998) concerns himself basically with question (2); and Edwards (1984, 1986) deal with questions (2), (3) and (4). Despite such intense discussion, the literature has not supplied a framework to simultaneously treat the four questions. To overcome this challenge, we propose Heckman (1974)'s sample selection model, which has been frequently used in labour market economics. In so doing, we bring to the field of international

development economics an approach that stresses the simultaneous character of the two main decisions made by an international investor: *when* and *how much* to lend to a foreign country. Our stylised model characterises these choices by way of two functions; one specifies the interest differential the importing country would be willing to pay (demand differential); the other, the interest differential the investor himself wants to receive (supply differential, or reserve price). Therefore, the macroeconomic approach is based on the monetary premium theory, which deals with the financial aspects of capital flows, without regard to its effects on the welfare of either the exporting or importing economies.

The empirical application occupies a substantial part of the paper. Special care was taken in the choice and construction of all the variables involved. An extensive analysis of the results is performed, linking them to all previous main findings in the literature. Though strong evidence is provided on the importance of the interest premium for the capital flows, other variables also play a significant role. Moreover, a “best econometric method”, which should be adopted in subsequent, similar studies, is clearly identified.

In what follows, Section 2 presents the model and the ensuing definition of equilibrium. Section 3 discusses the empirical implementation and the related econometrics, while Section 4 analyses the results obtained for the Brazilian economy. Section 5 extends the model under conditions of covered interest parity and Section 6 includes final considerations.

2. The model

2.1. Equilibrium

Building a functional form for the reserve price of international investors is at least uncommon; such far-from-trivial task is not within the scope of this paper. Here we assume that the function exists, and results from a maximisation made by agents possessing rational

expectations and monotonic preferences. Besides, we add the assumption that a monotonic transformation makes the additional interest rate a linear function of independent variables and the amount of capital that the investor is willing to lend.

The following structure is assumed for the capital supply curve to a small economy:

$$\delta^s = \alpha_0' x_0 + \beta k^s + v^* \quad . \quad (1)$$

The dependent variable (δ) should be understood as an interest rate differential sufficient to prompt the investor to offer the amount of capital k^s to a country. Vector x_0 represents a set of exogenous factors; α_0 is a (column) vector of constants with the same dimension of x_0 , and β is a constant scalar. The random error v^* will be examined later.

Demand for foreign capitals results from a rational choice of a representative agent. Contrary to the supply, demand is assumed price-inelastic, a consequence of the market power characteristic of any government or central bank¹. Again, a monotonic transformation makes the demand price a linear function of independent variables, so that:

$$\delta^d = \alpha_1' x_1 + v \quad . \quad (2)$$

Variable δ^d is the additional interest rate the receiving country is willing to pay to the foreign competitive capitalist. Vector x_1 represents the set of factors explaining the formation of such demand price, nothing preventing the existence of common elements in x_1 and x_0 ; α_1 is a vector of constants with the same dimension as x_1 . The error v will be examined later.

Let δ_0 be the supply additional interest rate – equation (1) – in a point where $k^s = 0$. If $\delta^d > \delta_0$, then the capital supplied by the international investors (k^s) is such that the supply and demand rates are even. In equation (1), this equilibrium is reached substituting δ by δ^d . Then, from (1) and (2), the inequality implies:

¹ In much the same way, one may see the representative agent as controlling the issue of securities in his own economy, while a coordinator agent of international investor's actions would not exist. The hypothesis of demand

$$\alpha_0'x_0 - \alpha_1'x_1 < v - v^* \quad ,$$

and international investors adjust the capital flow k^s to a point where

$$(\alpha_0'x_0 - \alpha_1'x_1) + \beta k^s = v - v^* \quad \text{or} \quad \alpha_0'x_0 + \beta k^s + v^* = \alpha_1'x_1 + v \quad .$$

The equilibrium equations of the model are:

$$\delta^e = \alpha_1'x_1 + v \quad \text{[equilibrium interest rate differential]} \quad (3)$$

$$k^e = \gamma x + \varepsilon = 1/\beta (\alpha_1'x_1 - \alpha_0'x_0) + 1/\beta (v - v^*) \quad \text{[quantity supplied at equilibrium]} \quad .$$

In general, if a positive quantity of a tradable good is purchased, demand and supply prices need to be equal to reach equilibrium. When the amount purchased is zero, the supply price is higher than the demand price. This argument applies to the model under discussion. The supply of capital will be null in case the inequality between the interest differentials of demand and supply is inverted [$\delta^d < \delta_0$]. Differently from what happens in the goods market, however, the lower limit for the net supply of capitals to a country is not necessarily zero. Even though capitalists adjust the flow k^s , the adjustment may not be sufficiently large as to match the interest differentials of supply (δ^s) and demand (δ^d). This may result, for instance, from obstructions that ultimately establish a limit κ for the outflow and prevent investors from perfectly adjusting their respective portfolios². But one may also elaborate on the hypothesis of increasing adjustment costs: at entrance, the liquidity restriction of the international market is negligible, and smooth adjustments can be assumed, while a sudden adjustment at exit would be prevented by high costs in the local market.

The occurrence of such mismatches will be named *default*, or events of default associated to sovereign risk. According to Obstfeld and Rogoff (1996, pp. 349), sovereign risk refers to any situation in which a government defaults its loan agreements with foreigners, seizes foreign

interest-inelasticity for capital is admitted, among others, by Chen and Khan (1997); Harberger (1980, pp. 336), however, describes a situation where the country importing capital pays increasing premiums.

assets located within its borders or prevents domestic residents from fulfilling their obligations with foreign creditors. Buchanan (1986, pp. 205) argues that default is equivalent to a discriminatory collection of taxes on individuals or corporations, both domestic and foreign, which hold debt instruments in their investment portfolios. All this leads to an enlargement of model (3).

2.2. *The restated model*

International investors pursue favourable conditions to the transfer of funds to the importing economy. At first, the capital owner checks whether or not the interest rate set by the would-be debtor exceeds the rate at which he would be willing to enter into a credit operation. The set of equations below formalises the procedures:

$$z^* = \delta^d - \delta_0 = (\alpha_1'x_1 + v) - (\alpha_0'x_0 + v^*) = \alpha_2'x_2 + u \quad , \quad (4)$$

$$z = 1, \text{ if } z^* \geq 0 \quad ; \quad z = 0, \text{ if } z^* < 0 \quad .$$

Vector x_2 contains all the variables included in x_0 and x_1 , the vector of coefficients α_2 being constructed accordingly; the error u equals $v - v^*$. The latent variable z^* , defined by the *selection equation*, measures the difference between the interest differentials. A positive difference implies a perspective of gain; a negative one, a perspective of loss. Variable z is just a dummy, set to unity when such difference is non-negative and to zero otherwise.

Following the possibilities of gain or loss, the profit-maximising capitalist turns to the determination of the volume of funds to be transacted. The functional representation is either (3), if $z=1$, or $k=\kappa$, if $z=0$. From an econometric point of view, this model is a limited/censored dependent variable one.

2.3. *The interest-rate differential*

² An emblematic case is Brazil itself, as can be seen in Articles 2 and 3 of the Federal Senate Resolution no. 82, of 1990, setting the conditions for re-negotiation of the Brazilian foreign debt. 5

Cole and Obstfeld (1991) argue that, considered the official restrictions, yields of comparable assets are, apparently, well arbitrated among countries (see also Harberger (1980)). Under this approach, the interest differential a country should pay does not need to exceed the opportunity cost but simply to equal it:

$$i - i^* = r^c + \tau + r^s \quad . \quad (5)$$

Equation (5) is a representation of interest parity where the differential between the domestic and foreign nominal interest rates ($i - i^*$) equals the exchange risk premium r^c , plus transaction costs τ and sovereign risk r^s . When no information asymmetry between the international investor and the sovereign debtor exists, the sovereign premium ($i - i^* - r^c - \tau$) may be regarded as compensation to the rational risk-averse investor, with full knowledge of the stochastic process that governs the realisation of default. According to Edwards (1984, 1986), the spread over the international reference interest rate charged against a given country is directly proportional to the probability that it commits default (see also Eaton and Gersovitz (1983)).

Intuitively, equation (5) suggests that, in order to encourage international arbitrators to incur in debt paying an interest rate i^* and transfer the funds to a rate of remuneration i , a country must set the latter so that the interest differential, net of transaction costs and exchange risk premiums, exceeds the perception held by such arbitrators on the sovereign risk inherent to the transaction. The same rationale would apply to the case of investors holding investments yielding i^* and willing to change them by assets yielding the interest rate i in another country.

Among the opportunity cost components, two are non-negotiable – the international interest rate and transaction costs. Exchange risk may almost always be transferred to a third party, given the prevalence of an insurance market. However, in general, there is no insurance market for sovereign risk. The sovereign risk premium may thus be understood, on the one

hand, as the interest rate differential δ^l that the borrowing country is willing to pay, and, on the other, as the interest rate differential $\delta^s (= \delta^l)$ the investor charges on the transfer of a capital amount of k^s . Given this, one may conclude that negotiations between borrowers and lenders in our model actually spin around the premium r^s .

3. Variables and econometrics

3.1. Estimation strategies

Heckman (1974, 1979) put forward an estimation process applicable to the class of models in Section 2. First, one estimates the parameters of the decision on whether to lend or not – equation (4) –, next, the results are used in a consistent estimation of the behavioural relation of interest. In our case, however, there are *two* relations of interest defined in (3): the equilibrium interest differential δ and the capital supplied k^s . We have then, in a second step, estimated the equilibrium interest differential according to Heckman's and, in a third step, the interest differential *estimated* in step two is used as an explanatory variable in estimating the capital equation in (3), which becomes:

$$k^e = 1/\beta (\alpha_1' x_1 - \alpha_0' x_0) + 1/\beta (v - v^*) = (1/\beta) \delta^e - 1/\beta (\alpha_0' x_0) - 1/\beta (v^*) \quad . \quad (6)$$

The gist of Heckman's idea lies in the fact that availability of actual information related to the equilibrium interest rate differential δ is restricted to the sub-sample $[z = 1]$. Estimation of the δ formation mechanism based on this subset of data induces the appearance of a “sample selection bias”. To overcome the problem, he suggested treating the “sample selection bias” as a specification error, corrected by including the inverse Mills ratio (λ_H), obtained from the explanatory variables in (4):

$$\lambda_H = \phi (\alpha_2' x_2 / \sigma_u) / \Phi (-\alpha_2' x_2 / \sigma_u) \quad , \quad (7)$$

where, ϕ and Φ represent the standard normal density and distribution functions, respectively.

The parameters of the probability that the difference between the demand and supply interest rate is non-negative (equation (4)) are first estimated through probit/normit analysis of the whole sample. Keeping in mind that the model treats the events $[\delta_0 > \delta^d]$ as default, the probit/normit analysis would answer two of the four initial questions: (3) what are the determinants of the probability of default? and (4) what process governs the realization of the events of default?

Replacing in (7) vector α_2 by its corresponding estimator $\hat{\alpha}_2$, we find a consistent estimator $\hat{\lambda}_H$ for the correction factor. Ordinary least squares (OLS) estimation for the equilibrium price is then performed on

$$\delta^e = \alpha_1' x_1 + \alpha_1 \hat{\lambda}_H + \chi \quad , \quad \text{with } \chi \sim N(0, \sigma_\chi^2) \quad , \quad (8)$$

and answers the second question posed in the introduction (What is the subjective interest rate differential building mechanism?).

Finally, to answer question (1) - What is the relation among capital flows, the subjective interest rate differential and other variables? - it suffices to take into account the potential rate/price differential measured in the previous step and, through tobit analysis of the whole sample, estimate equation (6), assuming normality of the errors ν^* .

The Heckman technique, however, has its application somewhat restricted as it is built on the assumption of normality of all errors: (u, ν^*, ν) must form a zero-means, multivariate normal. Breen (1996, pp.59) observes that non-normality, in the context of models with sample censoring or selection, is potentially very harmful. In the same lines, Goldberger (1983) suggests that the procedure for correcting the sample selection bias is very sensitive to small departures from normality. It seems clear that non-normality paves the road to questioning, but

the issue is somewhat weakened by the conclusions of Olsen (1980), who demonstrates that normality is a sufficient, though not necessary, condition for calculating the factor correcting the sample selection bias. On the other hand, Olsen (1980)'s demonstration has its validity restricted to situations where the error ν – equation (2) – is a linear function of the random variable u – equation (4) – according to the equation:

$$\nu = \rho_{\nu, u} (u - \mu_u) \sigma_u / \sigma_\nu + \eta \quad , \quad \eta \sim N(0, \sigma_\eta^2) \quad , \quad (9)$$

where μ_u and $\rho_{\nu, u}$ represent the mean of u and the correlation coefficient between ν and u , respectively.

If $u \sim U(0,1)$, Olsen (1980) also showed that

$$\lambda_O = (\alpha_2' x_2 - 1) \quad (10)$$

corrects the selection bias, provided α_2 is the estimator given by the linear probability model.

Lee (1983) overcame the limitation by proposing a generalised two-stage approach to correct the sample selection bias, of which Heckman (1979) and Olsen (1980) are particular cases. Considering, among other things, that the transform $J = \Phi^{-1}[F(u)]$ of the (absolutely continuous) distribution $F(u)$, of the random shock u in equation (4), is a strictly increasing function, he proves that the correction factor for the sample selection bias (λ_L) is duly calculated by:

$$\lambda_L = \phi(J(\alpha_2' x_2)) / \Phi(J(\alpha_2' x_2)) = \phi(\Phi^{-1} \circ F(\alpha_2' x_2)) / F(\alpha_2' x_2) \quad . \quad (11)$$

It can be easily seen that, being u normally distributed, (11) becomes equal to equation (7). Given the flexibility of Lee (1983)'s technique, beyond Heckman's and Olsen's, two other models with binary dependent variable were tested: logit (logistic-distributed error) and gompit (extreme-value distributed error); the latter using the following density function:

$$f(x) = \exp [-x - \exp(x)] \quad , \quad -\infty \leq x \leq +\infty \quad .$$

It is worth noticing that the difference between these two models lies on the assumption about the errors u in equation (4).

Since the normal and logistic distributions are similar, except on their tails, results based on probit/tobit and logit/tobit-lg models³ usually display little difference between them, except for samples with a significant number of large observations. The empirical implementation confirmed this, and estimation based on logit/tobit-lg was discarded. On the other hand, the performance of gompit/tobit-ev models was encouraging. The fact that the extreme-value distribution – negatively asymmetric – depicted the data behaviour better than the symmetric distributions previously attempted signals to the possibility of a “herd effect”.

3.2. The variables used

The empirical implementation was based on monthly data ranging from June 1991 to June 1998⁴. In 61 of the 85 observations, there is, simultaneously, a net inflow of capitals and an excess of positive return. Consequently, the censored sub-sample [$z = 0$], in equation (4), is reduced to 24 observations. Ideally, one should not estimate limited dependent variable models relying only on small samples, but a survey of monthly, or quarterly at most, data on something like a hundred of countries would be impracticable. Yearly data would operate against the use of arbitrage opportunities in smaller time intervals: a too much strong restriction, since international investors do quickly react to new information, and even the period of one month may sometimes be too long.

Table 1 presents the set of (exogenous) variables on the Brazilian economy considered in the process of composing vectors x_0 and x_1 ; their precise definitions may be found in the

³ The name tobit-lg shall be attached to a model with logistic distribution, and tobit-ev to the model with extreme-value distribution.

⁴ The selection of the June 1991 starting date is due to the issue of Resolution no. 1,832, by the National Monetary Council on May 31 of that year, establishing the Securities Portfolio Held in the Country by an Institutional Investor (Annex IV), a fund-obtaining instrument simpler and more flexible than the ones then in existence [Central Bank of Brazil (1998, pp. 4)].

Appendix. The first key endogenous variable is the Net Flow of Capitals exchanged between Brazil and the rest of the world. The second is the Interest Rate Differential, here understood as the premium Brazil paid to receive international capitals; two different ways - also precisely defined in the Appendix - were used to construct it. Figures 1 and 2 show the graphs of the endogenous variables.

Insert Table 1 and Figures 1 and 2 by here

In a first moment, as a measure for the premium r^s , the “excess return” defined by Lewis (1995) was used:

$$e^r = i - i^* - (s_{t+1} - s_t) \quad , \quad (12)$$

where s_t and s_{t+1} represent the demand exchange rates in the domestic market in periods t and $t+1$, respectively. The choice of an Uncovered Interest Parity (UIP) equation is justified by the fact that, in the period analysed, this is the one that better reflects the excess return foreseen in the model, since the Central Bank, besides holding the monopoly of foreign currency transactions, kept the base interest rate – the overnight rate – and the exchange rate under fairly strict control⁵. This environment of interest rate-inelasticity (or price-inelasticity) of the demand for foreign capitals is in line with the underlying assumptions of our model, particularly in what regards the fact that a country may set the price at which it is willing to receive foreign capitals.

In (12), one implicitly assumes that the effective devaluation of the domestic currency ($s_{t+1} - s_t$) is a good metric for the exchange rate premium, or that any existing difference has been incorporated into a more comprehensive idea of country risk. Besides, transaction costs

⁵ The exception is a brief interval from June 1994 and March 1995, where the exchange rate was under dirty float.

are disregarded. In the absence of arbitrage, this excess return shall be roughly equivalent to other metrics in the empirical literature, as for instance: the spread over the LIBOR, charged from the borrowing country – Eichengreen and Mody (1999) or Edwards (1984, 1986); the spread over the US Treasury Bond, charged in the secondary Brady Bonds market – Eichengreen and Mody (1998); or the spread over the US Treasury Bonus, charged in the secondary Interest Due and Unpaid Bonds market – Garcia and Barcinski (1996).

Excess return, instead of following Lewis (1995)'s UIP idea, can be computed after Frankel and MacArthur (1998), to whom the equation of covered interest parity (CIP), treated as a political risk premium, would be an appropriate measure of the degree of capital mobility or financial markets integration. There is a fundamental difference between the two concepts: exchange risk friction discarded, departures from CIP mean certainty of ex-ante gains, while departures from UIP mean no more than expectation of ex-ante gains. Within this new proposal, excess return is given by:

$$e^r = i - i^* - (f_t - s_t) \quad , \quad (13)$$

where f_t represents the exchange rate quotation in the domestic futures market.

Though the literature usually takes the above excess return as null, the change is justified because this fails to find empirical support: Frankel and MacArthur (1998), for instance, record that the CIP hypothesis is empirically confirmed when developed economies are compared, while it does not hold when comparing developed and developing economies.

The net inflow of capitals to be used in the estimations, in turn, encompasses all accounts of the autonomous capitals balance, deducted any operations with international organisations and government agencies. This refining was made because we intend to analyse the behaviour of capital flows sensitive to opportunities of financial gains, and official flows are not supposed to be affected by such opportunities.

4. Brazil's funding in the nineties

Table 2 summarises the results under Heckman (1979)'s technique. Several combinations of the variables listed in Table 1 were tried as components of vectors x_0 and x_1 ; those in Table 2 are the ones that featured a better explanatory power. The greatest simplification occurred in the probit analysis, which, theoretically, should include the variables both in the OLS analysis (vector x_1 , but for the correction factor) and in the tobit analysis (vector x_0 , but for the “excess return” variable). Nevertheless, three elements of x_1 (reserves, debt service and deviation) proved completely irrelevant in equation (4).

4.1. Probit analysis

The probit/normit analysis estimates the probability of occurrence of a positive net flow of capitals to the importing economy [$\delta^d > \delta_0$]. Even so, the values of the coefficients in equation (4) should not be directly interpreted as the marginal effect of the respective regressor on the probability of net inflow of capitals. Given a cumulative distribution function $F(\alpha_2'x_2)$, with density $f(\alpha_2'x_2)$, the marginal effect of variable x_{2i} , for instance, is the product $f(\alpha_2'x_2) \alpha_{2i} = \partial F(\alpha_2'x_2)/\partial x_{2i}$.

Table 2 indicates that four exogenous variables were significant in the determination of the probability that a net inflow of capital did take place in the Brazilian economy. For two of them, however, the level of significance is slightly higher than 5%. The impact is two periods lagged, what may be explained by either a delay in disseminating the information (several data are usually released with reasonable lags) or a delay by international agents in responding to such information, given transaction costs or the restrictions related to compliance with financial operation terms. Indeed, Froot *et alii* (1998) call attention to the possibility that agents holding

private information adjust their portfolios in a slow way, to reduce transaction costs; their empirical study suggesting that market indicators, especially in emerging countries, are slow to react to new information. However, Tesar and Werner (1995a), find evidence of a high turnover among markets for assets in OECD countries. They argue that this raises doubts on the relevance of transaction costs for decisions of international investors. The high turnover would suggest that market players respond to changes in economic conditions by performing frequent and significant changes in their portfolios.

Insert Table 2 by here

Regarding the role of each explanatory variable, the following could be added:

Foreign Shocks - Certain groups of countries are subject to common foreign shocks, which may affect both the costs and benefits derived from default, so that defaulting should not be exclusively assigned to domestic occurrences. In extreme situations, the diffusion of such shocks – the “contagion effect” (see Edwards (2000)) – may even make balanced economies vulnerable to currency attacks. Cardoso and Goldfajn (1997) argue that capital flows to a country generate externalities to its neighbours, and that a crisis in one country may also spread to others. In a case study of the Peruvian economy, Eaton and Gersovitz (1983) conclude that economic shocks were important in the triggering of crises. In turn, Froot *et alii* (1998) suggest that the positive correlation between flows channelled to different countries is a result of (global) shocks in international demand. At the empirical level, they reject the hypothesis of zero cross correlation between these net flows and, particularly, record increased correlations during the Asian crisis. Eichengreen and Mody (1999), however, in a cross section analysis of the 1991-1997 period, show that the geographic location of Latin America negatively affects

the probability of obtaining funds by companies and governments of the region. Such studies fail, so to say, to reject the hypothesis of “contagion”. In the same lines, Table 2 enables to infer that international disturbances – as the 1994 Mexican and 1997 Asian crises – negatively affected the confidence of investors in the Brazilian economy. Especially in what relates to the Mexican crisis – the “tequila effect” – Cardoso and Goldfajn (1977) reach a similar result.

Debt - Keeping constant all other related variables, the higher the foreign debt of a country, the more likely it will face difficulties to redeem it and the worse will be the quality of its securities. Consequently, domestic assets will be less attractive for international investors. Edwards (1984) considers indebtedness an indicator of a country’s degree of solvency, as “high indebtedness would be associated to a high probability of default” (pp. 730). Eichengreen and Mody (1998, 1999) find evidence that the foreign debt/GDP ratio negatively affects the probability of issuing new debt securities. The coefficient shown in Table 2 confirms this, signalling a negative effect of the net debt/GDP ratio on the probability of registering a net inflow of capitals to the Brazilian economy⁶.

Operating Deficit - Even under excess liquidity in the international credit market, the flow of funds to any economy is conditioned to the existence of demand. If demand is null, the probability of capital inflows tends to zero. Under this reasoning, and taking public deficit as a proxy for the demand for foreign capitals, a positive correlation between deficit and the probability of capital inflows to Brazil becomes defensible. The argument becomes stronger if, assuming no divergence between the perceptions of both the government and investors, the deficit level is seen as the result of an optimal selection of rights and obligations by the former. Notwithstanding, being indebtedness no more than the stock of deficits incurred along time, it

⁶ In the absence of information on the external debt, we selected the domestic debt because, to a high degree, funds entered into the Brazilian economy during the period analysed were, either directly or otherwise, channelled to finance the public sector.

would perhaps be more prudent to expect a negative coefficient. The dubious character of the deficit is confirmed by Eichengreen and Portes (1986), who, in three different samples, found one negative and two positive coefficients. As Table 2 shows a positive, though not significant, coefficient, one may conjecture that either the first effect is dominant over the second, or the deficit, by itself, is not a problem. However, the accumulation of deficits surely is, since the coefficient of the net (domestic) debt variable is negative.

Economic Openness - For Frenkel (1983), the more open an economy, the more it is vulnerable to external shocks, implying a positive correlation between openness and the probability of default. Eaton and Gersovitz (1981) use openness as a proxy for the penalty imputed to a debtor in case of default, to then argue that the more open an economy, the greater the implicit guarantee given to creditors, making room for the presence of a positive correlation between this openness and the willingness to lend. When studying the behaviour of the Brazilian economy in the 1980-1995 period, Cardoso and Goldfajn (1997) touch in a certain way this clash of ideas, since they suggest that capital control is efficient in the short-term and endogenous in the long-term. As Table 2 results come from monthly data, and as the lag is just two periods, the positive coefficient supports the alleged influence of openness on short run capital flows.

Stability - High inflation rates, by distorting the system of relative prices, brings uncertainty to the assets markets, turning them less attractive. Though temporary, a low rate of inflation may be perceived by investors as a signal of an austere macroeconomic policy. Under this line, the positive influence of the Real Plan dummy on the probability of foreign capital inflows to Brazil, shown in Table 2, is justifiable. Cardoso and Goldfajn (1997) reach the same conclusion.

Summing up, regarding the perception of international investors on loss perspectives, Table 2 shows that it is strongly influenced by indicators of external crises, solvency, economic openness and stability. The four variables reflecting this combination [shock, debt, openness and Real Plan] were selected because, among all those tested, a higher index of correctness (80.72%) was achieved. According to Maddala (1983, pp. 23), this seems a reasonable model choice criterion with a binary dependent variable. As shown in Table 3, there is a strong asymmetry in the correctness percentages. The pro-event [$z = 1$] bias may be a consequence of their larger number, but could also be read as a sign that the quality of information transmitted by the exogenous variables in periods when the capital flow is negative is not as good (or relevant) as when the flow is positive. Intuitively, in the case of inflows, investors would act based on the fundamentals, though not necessarily in the case of outflows.

Insert Table 3 by here

As said in Section 3.1, probit analysis answers two out of the four questions listed in the introduction. Remembering that the model assumes that events [$\delta^d < \delta_0 \Rightarrow \delta^d < \delta^s$] are equivalent to a default, the analysis calculates the probability of occurrence of capital inflows - or of absence of default -, the probability of default being obtained residually. Unfortunately, the validity of the normal distribution for the process governing the realisation of default events is debatable, as the Jarque-Bera statistics rejects the null of normality.

The α_2 coefficients obtained yielded the estimated values of the correction factor λ_H in equation (7). This factor is one of the explanatory variables of the OLS analysis.

4.2. OLS analysis

Estimation by ordinary least squares aims at evaluating the process forming the excess return – equation (3): the additional interest rate, or reserve price, at which international investors would be willing to channel funds to Brazil. Even if the number of observations on the supply of capital coincided with the sample size, the additional rate continues to have its realisations circumscribed to the selection $z=1$, in equation (4). As already said, OLS estimation of the additional rate, based on equation (3) and the selected sample, would result in a “sample selection bias”.

From equations (4), (7) and (8), one may easily conclude that the derivative of the expected equilibrium price is given by:

$$\partial E(\delta^e | z=1, x_1) / \partial x_{1i} = \alpha_{1i} - \alpha_{2i} \alpha_L [(\alpha_2' x_2) \lambda_H - \lambda_H^2] \quad , \quad (14)$$

α_{2i} being the coefficient of the variable $x_{2i} = x_{1i}$ in the probit analysis. The last term exists only when the explanatory variable in question is common to vectors x_1 and x_2 ⁷. In this case, it has a direct effect, measured by α_{1i} , and an indirect one, measured by $\alpha_L \alpha_{2i} [(\alpha_2' x_2) \lambda_H - \lambda_H^2]$, since λ_H is also a function of $x_{2i} = x_{1i}$. Otherwise, the value of the derivative boils down to the direct effect, α_{1i} ; the value when the reserve price is measured by equation (3). Breen (1996) states (without demonstrating) that the term $\alpha_L [(\alpha_2' x_2) \lambda_H - \lambda_H^2]$ is always positive. Thus, if the coefficient in the equation of the probability of capital inflows is positive, $\alpha_{2i} > 0$, the two effects are in opposite directions, and vice-versa.

Table 2 tells that, out of the five explanatory variables, only the correction factor fails to make a significant contribution to the formation of the equilibrium additional rate. Among other consequences, this implies that the probability of default does not affect the formation of the international investors' subjective interest rate. Sustaining such assertion is not an easy task, but, for the time being, we shall keep it as an open question.

The influence of each exogenous variable used to implement the OLS estimation will now be discussed:

Correction Factor - The technique used to estimate the model includes those periods with characteristics that would hamper the net inflow of capitals to the country, the estimation supposedly giving the expected value of the reserve price for the whole sample. In periods when the economic environment is not favourable, the equilibrium interest rate is presumably higher than the observed value (the rate set by the country demanding capitals), which is taken into account in the estimation. This suggests that the procedure biases the expected value down. The correction factor (always positive), with a positive coefficient, counteracts such distortion. The coefficient displayed in Table 2, though positive, is not statistically significant at the 10% level.

From the econometric viewpoint, nullity of the correction factor coefficient is simply a sign of absence of selection bias. Intuition, however, favours the hypothesis that including the censored sample distorts the estimates, since the characteristics of the periods during which there was a net inflow of capitals surely differ from those of periods when this inflow failed to happen. The fact that a statistically zero coefficient is common in many applied works does not necessarily solves these questions.

From the economic viewpoint, the result is questionable because, being the probability of exit of foreign funds – occurrence of event $[\delta^d - \delta_0 < 0]$ – associated to a perception of the country's sovereign risk, theory says that this perception has an impact on preferences, which reflects on the additional interest rate. Buiter (1983) observes that what potential lenders try to appraise is the probability of default by a debtor. In these same lines, Feder and Ross (1982) found evidence that the perception of risk by lenders is systematically reflected in spreads.

⁷ What, though theoretically always happening (see equation (4)), may not take place in practice, as the variable

International Reserves - When considering the demand of a country for borrowings, the key point assessed by an investor is the solvency of the potential debtor. In a long-term perspective, solvency is secured when the inter-temporal budget constraint is respected and, in principle, there is no default. In the short-term, however, contamination of expectations may lead the country to insolvency, by undue association of a liquidity squeeze to poor economic management. Dissociation between short-term assets and liabilities leads to a liquidity crisis in two circumstances: either when a significant part of creditors believes that the country will not honour its obligations because the remaining part of creditors will not continue to grant loans to it; or when there is contagion. The universal liquidity indicator of a country is its level of international reserves, supposedly perceived by investors as a collateral. Thus, in the two previous situations, a strong position in reserves increases the confidence of foreign credit market players and weakens the thrust of irrational behaviour. Following a converse way of reasoning, Feldstein (1999) considers reserves as important in a country self-protection, since they operate as a guarantee that it would not be victimised by speculative attacks. This is just another way of looking at the same problem: since the country is safe, safe are also those who granted credit to it. All other things constant, the higher the volume of reserves, the better the quality of the country risk. In an empirical exercise, one should expect a negative correlation between the rate charged in external funding operations and the level of reserves. This is confirmed by Edwards (1984), Min (1998), Eichengreen (1999) and, in the specific case of the Brazilian economy, in Table 2.

Debt Service - The debt service/exports ratio has been largely used as an indicator of security of loans granted to sovereign economies. Williamson (1993) even mentions a “pocket rule”, according to which the debt service/exports ratio should not be higher than 0.25. The benefit of

a default is larger the higher the debt service/exports ratio, so that a rational agent would charge an interest differential that is an increasing function of such variable. Eaton and Gersovitz (1983) point that a country featuring a higher debt service/exports ratio would be preferable, because the ratio would merely reflect other aspects perceived by capitalists as risk reducers. Empirical investigations by Eichengreen and Mody (1998, 1999) and Min (1998) agree to this assertion and the same do the results shown in Table 2.

Consumption Deviation - For Eaton and Gersovitz (1983), external indebtedness enables a country to dissociate, at any moment, its level of consumption from that of income, by setting the level of savings. Default would close access to foreign capitals and, consequently, increase the variance of consumption and reduce welfare. The increase in cost represented by the consumption variance could then mean an implicit guarantee for a foreign investor, justifying a reduction of rates charged in loan operations. According to Table 2, this reasoning does not apply to Brazil, since the coefficient of the standard deviation of consumption is positive. It should be noticed, however, that capital-importing countries are almost always poor and, therefore, the marginal utility of consumption in such countries is relatively high. In periods of low production, the marginal utility of consumption reaches even higher levels, the social cost of the debt service becomes unbearable and default inevitable. The consumption variance should then be seen not as a guarantee, but as a threat to a foreign creditor, and the relation between the differential of the interest rate charged by suppliers of foreign capitals and the consumption deviation should be adequately represented by a positive coefficient.

Economic Openness - For Fernandez-Arias and Montiel (1995), during the nineties, capital flows to developing countries were affected by changes associated, among other things, to the regulatory structure. Dooley and Isard (1980), in turn, interpret political risk as the probability that, in a given country, controls may be imposed on capital flows. Their results are

impressive: capital controls would be responsible for interest differentials which would represent 71% to 77% of the average differential recorded among deposits in euromarks (Zurich) and the inter-bank market for marks (Frankfurt), in the period from January 1970 to December 1974. In the same line, capital controls are included among the four reasons pointed out by Marston (1997) as responsible for the lack of observance of the interest-covered parity. He measured the differential between rates charged on agreements in three different periods: (1) pre-Bretton Woods (April 1961 to April 1971), with capital controls – differential of 0.78% per annum; (2) post-Bretton Woods (January 1973 to June 1979), with capital controls – average differential of 1.50% per annum; and (3) post-Bretton Woods (July 1979 to March 1991), without capital control – average differential of –0.03% per annum⁸.

The more closed an economy, the lower the information exchange between it and the rest of the world. The capital account openness, however, reduces the asymmetry of information between a capital-importing country and its potential international creditors. On the other hand, assuming that in a closed economy the costs of default are relatively smaller, economic openness would signal the firm intention of the debtor country in redeeming its debts, with an immediate and favourable reflection on credit prices.

For the openness variable, Table 2 displays a negative coefficient in the OLS analysis and a positive one in the probit analysis. Assuming like Breen (1996) that $\alpha_L [(\alpha_2'x_2)\lambda_H - \lambda_H^2]$ is positive over the whole sample, taken to equation (14), these signs guarantee that opening the capital account reduced the interest rate charged by foreign investors in loans operations to Brazil, a conclusion in keeping with the arguments of the previous paragraphs.

The OLS analysis has shown that: i) the probability of default, inserted in the vector of explanatory variables by means of variable λ_H , had no statistical influence in the formation of

⁸ For other cases, and more details, see Martson (1997) Chapter 3.

the investors' reserve price; and ii) one liquidity indicator (reserves), two of solvency (ratio debt service/exports and consumption deviation) and one of transparency (openness) were significant in the formation of the equilibrium interest rate differential.

4.3. Tobit analysis

The probit analysis showed that four variables – external shock, domestic net debt, capital account openness and the Real Plan dummy – were statistically important in the definition of the first choice of international investors: whether or not to lend. The second choice – how much to lend – hinges on the first. This dependence would be sufficient to guarantee the existence of correlation among them and, in a certain way, explains why both are influenced by the same variables; what brings back the arguments enumerated in the probit analysis. This coincidence is not necessary though, since the two analyses deal with different processes: the operating deficit, for instance, is significant only in the second decision. As questions (3) and (4) were the object of probit analysis, and question (2) of OLS analysis, it remains to the tobit analysis answering the first question.

The condition of convergence to equilibrium – with the supply of capital adjusting the supply interest rate differential (δ) until it equals the interest differential set by the importing country (δ') – indicates an expressive relation between equilibrium prices and quantities. It is therefore disappointing that Table 2 shows a statistically null coefficient for excess return, implying a vertical supply curve; an unjustifiable conclusion from the viewpoint of the model's equilibrium. The relevance of this coefficient is additionally strengthened by theoretical arguments and empirical results that support the importance of international reserves, of the foreign debt service/exports ratio and the consumption variance, whose information is transmitted to excess return.

The supposed price-inelasticity of the supply curve should at least be seen with a degree of caution since, in addition to a high average, the estimated equilibrium excess return has a very high variance. Subtracted of one unit of standard deviation, the average value of excess return is equivalent to a yield of 7.75%, which collapses to zero when the subtraction is 1.24 units of standard deviation – the average yield/standard deviation ratio⁹.

In addition to the questions raised by the price-inelasticity of the supply curve, it should be remembered that the OLS analysis revealed a null coefficient for the correction factor of the sample selection bias and that Heckman (1979)'s technology is based on the normality hypothesis - rejected by the Jarque-Bera statistics in the probit analysis –, the starting point for calculating the correction factor. Use of Olsen (1980)'s correction factor given by (10), with both OLS and weighted least squares, failed to bring any progress when compared with the results previously obtained.

5. Improved estimation and use of the covered parity relationship

5.1. A superior technique

Substantial gains were obtained by using Lee (1983)'s technique, with the same explanatory variables as in Table 2. Given that, as Table 4 shows, no coefficient changed sign, the discussion in Section 4 remains valid. However, differences in significance between the results deserve mention.

With the exception of the operating deficit, whose coefficient remains statistically null at 10%, the results of the gompit analysis are qualitatively better than those of the probit analysis; all coefficients are higher in absolute value. Besides, the series of the sample selection bias correction factor also changed.

⁹ The excess effective (realised) average return becomes null with the subtraction of just 0.4 units of standard

In the OLS analysis, the coefficient of the correction factor is now significant at 5%. This confirms the assumption that inclusion of events the characteristics of which prevent the net inflow of capitals biases down the estimate of the expected equilibrium interest rate differential. The correction factor and its coefficient are positive and, therefore, multiplying one by the other increases the estimated value for the equilibrium interest rate differential. For the sake of comparison, the average values of the excess return estimated *a la* Heckman (1979) and *a la* Lee (1983), respectively, subtracted of one unit of standard deviation, imply a yield equivalent to 7.75% per annum and 4.42% per annum. They become zero when the subtraction factor is 1.24 and 1.15 units of standard deviation, respectively. As the coefficient α_L in equation (8) is equivalent to the product of $\rho_{v,u}$ (correlation between v and u) by σ_v (standard deviation of v) – see Heckman (1979), Maddala (1983), Dhrymes (1984) or Breen (1996) –, the result confirms, in addition, the existence of a correlation between the stochastic processes that govern the behaviour of the differential $[\delta^i - \delta]$ and the formation of the equilibrium rate (δ) itself.

The coefficient of the operating deficit in the capital supply function, significant at 10% in the estimation *a la* Heckman, is statistically null in Table 4. This variable was admitted under the assumption that it would represent a proxy for foreign capitals demand. In view of the econometric results, two interpretations emerge: i) being the supply of foreign capital small relatively to the size of the demand posed by the importing country, aggregate demand would not limit the individual supply, although it could affect the supply by investors as a whole; or ii) information related to the demand for capitals has already been incorporated to the interest differential (δ^i) set by the importing economy.

The marginal effect of the domestic net debt, in Table 4, exceeds in absolute terms that of a foreign shock, both in the gompit and in the tobit-ev estimation. When deciding about a credit operation, and on the amount involved in it, international investors gave less importance to the contagion than to the solvency indicator. The relevance of the debt variable is additionally stressed by a higher influence over the behaviour of the capital supply than the one manifested by the openness and stability indicators. In the case of openness, the result of the tobit analysis in Table 4 (and already in Table 2) contradicts Garcia and Barcinski (1996), for whom the legal restrictions imposed by the government were not sufficient to avoid an inflow of foreign capitals to the Brazilian economy.

Figure 3 shows the behaviour of the estimated excess return – based on equation (9) –, obtained in the Heckman and Lee results. Though both fail to capture the wild variation in the last months of 1991, Lee's results (Figure 3.b) show a larger swing than Heckman's (Figure 3.a) and seem to portray better – even if with less volatility – the actual series in Figure 2.a. Both excess returns estimates still display a somewhat high variance, which could be interpreted as a sign of high risk. To dodge this problem, one may conjecture that investors have low risk aversion, their concerns being limited to the expected value of excess return. Eichengreen and Mody (1999) stress that, during the 1977 Asian crisis, spreads of bank loans recorded little variation compared to bonus spreads, raising doubts on the correct pricing by banks of the country and credit risks involved in the transactions¹⁰.

Insert Table 4 and Figure 3 by here

¹⁰ However, one should keep in mind that banks may rely on services provided by the lender of last resort, seen by many as an implicit guarantee. Besides, it becomes increasingly recurrent the idea that banks and bondholders rely on the perspective of the International Monetary Fund – IMF assistance to the debtor country so that, in any sudden crises, they could redeem their funds.

The tobit-ev analysis implies a positive and statistically significant relation between price and quantity – i.e. the supply of capital and the excess return desired by the investor. This is, by far, the most suggestive among the differences emerging from a comparison between the results generated by the two techniques. Moreover, it confirms the hypothesis of a non-null capital supply price-elasticity, a necessary equilibrium condition assumed in the building of our model.

Under certain assumptions on the flow of factors - absence of international trade, no labor mobility, and production functions identical for the economies analyzed -, the classical theory takes the expected rate of return as the sole determinant of the international flow of capitals. Given the magnitude of the excess return coefficient, the result of the tobit-ev estimation goes in the direction of neoclassical thought. The fact that (apparently) the interest rate elasticity by and large exceeds the debt elasticity may have a simple explanation: when the investor is concerned with the amount of the credit operation, the risk of default has already been assessed and accepted (indeed, priced), and from then on return is the main concern.

Evidence of a contemporary positive correlation between net inflows and asset returns is shown, for instance, in Tesar and Werner (1995a,b) and in Brennan and Cao (1997). Though agreeing that changes of assets between OECD countries are an indication of home bias, Tesar and Werner (1995a) suggest that transaction costs and less-than-complete information would not be barriers to stop international investors in their pursue for return. Brennan and Cao (1997) reason that international investors update their forecasts more often than domestic investors. This is because the former are in a position of information disadvantage as regards the latter and therefore positive news causes a relocation of domestic assets towards international investors. Froot *et alii* (1998) advance another explanation for a contemporaneous positive correlation between net inflows and asset returns, stemming from demand shocks unrelated to information. Shocks that increase the risk-tolerance of international investors – compared to

the one of domestic investors – would raise the price of domestic assets, entailing a redistribution of asset balances. Similarly, an exogenous shock capable of increasing (or decreasing) the wealth of international investors would cause a reshuffling in the demand for domestic assets that could simultaneously affect prices and quantities.

If the supply of capital is the endogenous response of investors to the perception of a profitable business opportunity, one may infer from Table 4 that the premium measured in equation (12) would in fact be an indication of excess expected return. Regarding the Brazilian economy in the first half of the nineties, Garcia and Barcinski (1996) claim that the main determinant of net foreign capital inflows was the gigantic differential between domestic and foreign interest rates. Without attempting to contest the relative importance of the interest rate on flows, this differential resulted, on the one hand, from reduced international interest rates, mainly in the United States; and on the other hand, from higher domestic rates.

The above remark brings into the discussion an important issue, purposively left untouched till now: the behaviour of international interest rates. Everything else constant, the higher they are, the higher will the excess return be and, consequently, the larger will be the net supply of capital – the push effect¹¹. The interpretation is straightforward: a reduction in foreign interest rates promotes identical moves in the price of domestic securities, contrasted to the price of foreign securities. This causes an excess demand for the domestic securities and, promptly, a steady net inflow of capitals to the domestic economy, until equilibrium is re-established.

Eichengreen and Mody (1999) find a positive relation between the supply of bank loans to developing countries and the international interest rate; and a negative relation between the

¹¹ In a comprehensive way, the push effect relates to short-run foreign conditions to the capital importing economy. Fernandez-Arias and Montiel (1995, pp 25) argue that, at the beginning of the fifties, the push effect would have dominated the pull effect, the latter attributed to better return on securities and credibility of the country receiving capitals.

supply of loans and spread. The segregation of their sample breaks this logic, since it indicates a reduction in spread, with no significant change in the supply of bank loans to East Asian countries; and an increase in both spread and supply of loans to Latin America. This points out the relevance of geographical location for price formation.

Eichengreen and Mody (1998) reach the conclusion that the international rate of interest and the price of bonds issued by emerging countries move in the same direction. Although recognizing that an increase in international interest rates results in some retraction in the demand for emerging countries' bonds, they ascribe the increased price of such bonds to a smaller supply – fewer countries would go to the market and the decline in supply would be sufficient to increase the bonds' price. When the sample was separated, they realised that the market for bonds issued by Asian countries replicates the behaviour of the market for bank loans, as described in the previous paragraph. This was not the case for Latin countries, since an increase in the international rate of interest implied a drop in the price of their respective bonds, lower issuances and larger spreads. Regarding these differences, it must be remembered that, although domestic absorption has increased in the two regions, the movement in Asia was generally a reflection of increased investments, while in Latin America consumption was dominating, Fernandez-Arias and Montiel (1995).

Finally, one of the most controversial results is in Kamin and Kleist (1999): they do not identify a statistically significant relation among several measurements of industrialized countries interest rates and the spreads in new issues of bonds by emerging countries. Besides, the same conclusion applies to spreads of Bradies.

Within the scope of our model, no conclusive evidence can be provided on these issues.

5.2. Using the covered parity relationship

In Section 3 we mentioned that the literature relies on several alternatives to measure the interest differential. A consensus does not exist on the direction in which the international interest rate affects capital flows, which, under some hypotheses, may be extended to the interest differentials between importing and exporting economies. We now use the CIP metric (equation (13)) to build the excess return variable used in estimating the potential price of capital supply and, based on this new estimated price, the capital supply function for Brazil.

Table 5 shows the results of the OLS estimation of equilibrium excess return measured by CIP – graphically depicted in Figure 4 – and of the tobit-ev estimation for the capital supply associated to the estimated excess return. Out of the variables that significantly affect the formation of the excess return evaluated by UIP only two – correction factor and reserves – perform the same role in the case of CIP. Regarding the tobit-ev analysis, an indication is clear that the excess return evaluated by CIP (Political Risk) positively affects the capital supply. Looking at the covered differential as a certainty of ex-ante gain, an unquestionable result stands out: capitalists take advantage of the excess profit opportunities.

Insert Table 5 and Figure 4 by here

Notwithstanding, when the covered differential is perceived as a risk premium, there is no reason to be so peremptory. Two plausible additional interpretations remain: either international investors are risk neutral and, for them, the supposed political risk premium in fact indicates an addition to the expected value of the excess return, or the covered differential exceeds the risk premium accepted as fair by international investors, i.e., even discounting the risk premium, investors reached the conclusion that there is a positive expected value for excess return.

6. Final considerations

The purpose of this paper was to introduce a new framework for explaining private capital net flows between the rest of the world and a small economy. Despite its simplicity, the proposed approach – following the theory of monetary premium – enabled the simultaneous treatment of four key questions, closing a gap in the international finance literature. By means of our stylised model, net exchanges of capitals between Brazil and the rest of the world in the nineties were analysed, using estimation techniques developed by Heckman (1979) and later enhanced by Olsen (1980) and Lee (1983).

In order to select the distribution that better fits the process governing the realisation of default, three symmetric-distribution binary models were evaluated – probit, logit, and linear probability – together with an asymmetric-distribution one – gompit. The four models displayed similar performances, with an index of accuracy of about 80%. However, the asymmetric distribution hypothesis led to more consistent results, both from the econometric and economic viewpoints. Based on the chosen (extreme value) distribution – the gompit model –, five indicators had an important influence on the probability of default: the Mexican-1994 and Asian-1997 crises; the public sector balance of net domestic debt; the public sector operating deficit; the trend of regulatory barriers on capital flows; and the implementation of the Real Plan. Four among them were statistically significant.

Regarding the subjective interest rate building mechanism, the study suggests that the interest rate differential that equilibrates demand and supply of foreign capitals was significantly linked to: i) the level of international reserves – Brazil's liquidity; ii) the debt service/exports ratio; iii) the standard deviation of consumption; and iv) the trend of regulatory barriers on capital flows. The significant presence of the sample selection correction bias as a

fifth explanatory variable supports the idea that, when the assessment of the probability of default of the Brazilian economy changes, this is reflected in the spread in the credit operations granted to Brazil.

The interest rate subjective differential estimation was, therefore, considered in the specification of a function reflecting the potential supply of foreign capitals to Brazil. Besides the (estimated) interest differential itself, external shocks (contagion effect), solvency, capital account openness and price stability appeared as significant. Although one may not identify the predominant influence, the changes in capital flows were determined by foreign factors – push effect – and by domestic factors – pull effect. In a different perspective, the changes were due to permanent and temporary factors: among the former, the capital account openness; and among the latter, the Mexican and Asian crises.

The variable that more strongly affected the entrance of capitals was the interest rate differential, stressing in a certain way the classical viewpoint that the expected rate of return is *the only* determinant of the international flow of capitals. The significance of the capital account openness signals that, at least in the short-term, regulatory barriers were determinant. Regarding the contagion indicator, the sign of the estimated parameter indicates that the Mexican and Asian crises prejudiced the perception international investors had on the quality of credits granted to the Brazilian economy. Price stability brought by the Real Plan positively influenced capital flows, thanks to, if by no other reason, the reduction of uncertainties regarding asset prices.

Appendix. Description of the Variables Used in the Estimation of the Model¹²

External Shock – This is an indicator of the Mexican and Asian crises, analogous to those used by international firms like, for instance, J.P. Morgan. It is a categorical index whose impact diminishes

arithmetically with time, disappearing from the seventh period onwards: 1 (month of the shock: 12/94 – Mexico; 07/97 – Asia), then 5/6, 4/6, 1/2, 1/3, and 1/6.

Gross Domestic Product (GDP) - Twelve-months aggregate product, at prices of the end of the last month of the period, deflated by the centred IGP-DI (geometric average of IGP-DI changes in the last month of the twelve-months period and in the subsequent month)^(*).

Exports/GDP Ratio - Value of monthly exports^(*), divided by 1/12 of yearly aggregate GDP.

Imports/GDP Ratio - Value of monthly imports^(*), divided by 1/12 of yearly aggregate GDP.

Net Trade Balance/GDP Ratio - Difference between monthly exports and imports, divided by 1/12 of yearly aggregate GDP.

Trade Balance/GDP Ratio - Monthly exports and imports, divided by 1/12 of yearly aggregate GDP.

Foreign Debt Service – Defined as the monthly flow of debt service – namely, monthly values related to Portfolio Capital Returns, Amortisation of Currency Loans, Interests and Amortisation of Supplier/Buyer Credits^(*) - divided by the value exported over the same period.

Portfolio Capitals - In their majority comprising: (1) funds channelled to diversified portfolios of securities and stocks – owned by institutional investors – entering into the Brazilian economy under the National Monetary Council Resolution no. 1,289 – “Annexes I to IV”; (2) funds channelled to investment in stocks of Brazilian companies by the Depositary Receipt mechanism, their flow being regulated by the National Monetary Council Resolution 1,848 – “Annex V”; and (3) funds owned by juridical persons domiciled or having head office abroad, channelled to purchase of Fixed Income Funds – Foreign Capital quotas, under the National Monetary Council Resolution no. 2,028 – “Annex VI”.

GDP Growth - For each month, the rate of GDP growth accumulated over the past twelve months, as against the previous month.

International Reserves/GDP Ratio - Stock of international reserves of the Central Bank of Brazil (concept of international liquidity)^(*), divided by the twelve-months' aggregate GDP.

Capital Account Openness - An index reflecting the trend of the regulatory structure applicable to the flow of autonomous capitals in Brazil. The procedure is similar to the one used in Cardoso and Goldfajn (1997); more precisely, each liberalizing measure contributed with (+1) to the index, while each restrictive measure contributed with (-1)¹³.

Net Domestic Debt/GDP Ratio - Public sector net domestic debt, divided by twelve-months aggregate GDP. The public sector net domestic debt is the debt stock at the following three government levels:

¹² Not all variables appear in the final results.

^(*) The source of all variables with this asterisk is the Central Bank of Brazil.

¹³ The list of the 78 regulatory documents – decrees, directives, resolutions, communiqués, etc. – involved in building the index is available upon request.

Federal Government and Central Bank- Security debt outside the Central Bank; Bank debt; Collectable taxes; Social Security; Autonomous entities; Ministerial Advice MF-30; Privatization Certificate – overdue and renegotiated debt plus agrarian debt securities; Worker Support Fund (FAT); State and Municipality securities; Monetary base; Deposits in NCz\$ with the Central Bank of Brazil (Law no. 8,024); Special remunerated collection; Other deposits with the Central Bank; Central Bank credits to financial institutions; Other accounts; Funds portfolio; Debt assumed by the Federal Government (Law no. 8,727/93); Federal Government Credits (Law no. 8,727/93);

State and Municipality Governments- Security debt outside the Central Bank; Security debt within the Central Bank; Securities in treasury; Bank and autonomous entities debt; Collectable taxes; Demand deposits and autonomous entity deposits; Ministerial Advice MF-30; Renegotiated debt (Law no. 8,727/93);

State Companies- Bank debt; Demand deposits, Contractors and suppliers, Debentures, State companies' portfolio; Ministerial Advice MF-30; Renegotiated debt (Law no. 8,727/93)^(*).

Public Sector Net Foreign Debt - Foreign net debt at the three government levels (Federal Government and Central Bank; State and Municipality Governments; State Companies^(*)).

Total Public Sector Net Debt/GDP Ratio - Public sector net domestic debt plus net foreign debt divided by twelve-months' aggregate GDP.

Operating Deficit/GDP Ratio - Monthly public sector borrowing requirements^(*) divided by 1/12 of yearly aggregate GDP.

Product Standard Deviation - Standard deviation of the last six observations of twelve-months aggregate GDP.

Consumption Standard Deviation - Standard deviation of domestic industry physical production of non-durables and semi-durables over the past six months¹⁴.

Capital Supply/Net Flow - Encompasses net values of the following accounting items: Direct Investments (Currency, Goods and Conversion); Portfolio Capitals (Annexes I to IV, Annex V, Fixed Income Funds, Other Funds); Supplier/Buyer Credits; Currency Loans (Inter companies, Commercial Papers, Bonds, Banks, Notes, Securitisation, Other); Short-term Capitals (Credit Lines, Operations with Institutions Abroad, Agribusiness Loans, Other). Thus, the following of the balance of payment autonomous capital account flows was not included: Funding from International Organisations and Government Agencies^(*).

Domestic Interest Rate - Measured by data on the adjusted average of funding collected in the Special System of Clearance and Custody (SELIC) for federal securities in the first business day of each month^(*).

¹⁴ Data on consumption kindly supplied by Mr. Frederico Sampaio (Pontifical Catholic University – Rio de Janeiro).

International Interest Rate - Measured by data on the monthly US interest rate (FED FUND; see www.frb.org).

Demand Exchange Rate - Measured by the free exchange rate market average rate (PTAX), applicable to the settlement of federal securities maturing on the first business day of each month, i.e., the closing rate of the last business day of the previous month, so that a comparison between two observations yields the effective devaluation in the elapsed period^(*).

Futures Exchange Rate - Adjustment rate of the US dollar in the first business day of each month, as appears in exchange agreements to be settled in the first business day of the subsequent month (source: Commodities and Futures Exchange).

Prices - Interest covered parity, interest uncovered parity.

Transaction Costs - In the domestic demand exchange market – half the rate that would equal the minimum and maximum values of purchase for sale in the free exchange market, recorded by the Central Bank in the first business day of the period (month) under analysis; in the domestic futures exchange market – half the rate that would equal the minimum and maximum values reached in futures exchange agreements, recorded by the Commodities and Futures Exchange, in the first business day of the period, the settlement of such agreements in the first business day of the period following the period analysed; in the domestic securities market –half the difference between the maximum and minimum rates reached by the SELIC¹⁵ index in the first business day of each month, according to the Central Bank records; in the foreign securities market – the value calculated by Clinton (1988), common to five countries: the US, the UK, Canada, Germany and Japan.

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¹⁵ Weighted average rate adjusted to overnight funding recorded in the Special System of Clearance and Custody (SELIC) for federal securities.

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Table 1

Possible Elements of Vectors x_0 and x_I

Exogenous Variables	Description
Shock	Mexican and Asian crises
Openness	Capital account openness
X	Exports/GDP ratio
M	Imports/GDP ratio
BC	Balance of trade/GDP ratio
CE	Foreign trade/GDP ratio
Debt Service	Debt service/Exports ratio
ΔY	GDP growth
Reserves	International reserves/GDP
Debt	Domestic public sector net debt/GDP ratio
TPSND	Total public sector net debt/GDP ratio
Deficit	Operating deficit/GDP ratio
Real Plan	Stability (in the Brazilian case, Real Plan dummy)
σ_y	GDP standard deviation
Deviation	Consumption standard deviation
Endogenous Variables	Description
Correction	Sample selection bias correction factor
Interest Rate Differential	Premium to be paid by a borrowing country to receive international capitals.
Capital Supply	Net flow of capitals exchanged between a small economy and the rest of the world

Table 2

Net monthly flow of private capitals, June 1991 to June 1998 (Heckman's; UIP)

Variable	Coefficients	Deviation	p-value
Net Inflow of Capitals – Probit Analysis			
Constant	-9.1718	4.3330	0.0343
External Shock (-2)	-1.3791	0.7078	0.0514
Net Domestic Debt (-2)	-3.8006	1.8155	0.0363
Operating Deficit (-2)	4.8076	4.1490	0.2466
Openness (-2)	1.0788	0.5793	0.0626
Real Plan (-2)	2.2952	0.7173	0.0014
Excess Return Measured by UIP – OLS Analysis			
Constant	-0.0123	0.0324	0.7057
Correction (λ_H)	0.0467	0.0334	0.1679
International Reserves (-2)	-0.0308	0.0068	0.0000
Foreign Debt Service (-2)	0.0158	0.0068	0.0236
Consumption Deviation (-2)	0.1648	0.0940	0.0851
Openness (-2)	-0.0229	0.0079	0.0055
Net Inflow of Capitals – Tobit Analysis			
Constant	-2.35643	0.7286	0.0004
Excess Return	2.4233	2.5532	0.3425
External Shock (-2)	-0.3899	0.1215	0.0013
Net Domestic Debt (-2)	-0.8044	0.2980	0.0070
Operating Deficit (-2)	1.1284	0.6597	0.0872
Openness (-2)	0.4240	0.1186	0.0003
Real Plan (-2)	0.5309	0.1173	0.0000

Table 3

Correctness index in the binary model

Description	Estimated Equation		
	Z = 0	Z = 1	Total
Probability that $(z=1) \leq 0.5$	11	4	15
Probability that $(z=1) > 0.5$	12	56	68
Total	23	60	83
Correct	11	56	67
Percentage Correct	47.83%	93.33%	80.72%

Table 4

Net monthly flow of private capitals; June 1991 to June 1998 (Lee's; UIP)

Variable	Coefficients	Deviation	p-value
Net Inflow of Capitals – Gompit Analysis			
Constant	-14.2142	6.1051	0.0199
External Shock (-2)	-2.0182	1.0004	0.0437
Net Domestic Debt (-2)	-6.0994	2.6807	0.0229
Operating Deficit (-2)	5.6979	5.4906	0.2994
Openness (-2)	1.6788	0.7611	0.0274
Real Plan (-2)	3.6018	1.1363	0.0015
Excess Return Measured by UIP – OLS Analysis			
Constant	-0.0158	0.0312	0.6140
Correction (λ_L)	0.0899	0.0400	0.0287
International Reserves (-2)	-0.0295	0.0066	0.0000
Foreign Debt Service (-2)	0.0151	0.0065	0.0251
Consumption Deviation (-2)	0.1575	0.0899	0.0853
Openness (-2)	-0.0209	0.0077	0.0090
Net Inflow of Capitals – Tobit-ev Analysis			
Constant	-3.6760	0.7616	0.0000
Excess Return	6.0625	2.6112	0.0202
External Shock (-2)	-0.3120	0.1418	0.0276
Net Domestic Debt (-2)	-0.9559	0.2736	0.0005
Operating Deficit (-2)	0.9463	0.7751	0.2221
Openness (-2)	0.7167	0.1281	0.0000
Real Plan (-2)	0.7097	0.1305	0.0000

Table 5

Monthly net flow of private capitals; June 1991 to June 1998 (Lee's; CIP)

Variable	Coefficients	Deviation	p-value
Excess Return Measured by CIP (Political Risk Premium) – OLS Analysis			
Constant	-0.0859	0.0162	0.0000
Correction (λ_L)	0.2176	0.0553	0.0002
International Reserves (-2)	-0.0284	0.0069	0.0001
Net Inflow of Capitals – Tobit-ev Analysis			
Constant	-4.5968	0.9483	0.0000
Political Risk	7.9894	3.0621	0.0091
External Shock (-2)	-0.4661	0.1604	0.0037
Net Domestic Debt (-2)	-1.2983	0.3093	0.0000
Operating Deficit (-2)	1.6702	0.7847	0.0333
Openness (-2)	0.7596	0.1307	0.0000
Real Plan (-2)	1.0235	0.2183	0.0000

Fig. 1. Monthly flow of private capitals to Brazil, from July 1991 to June 1998.

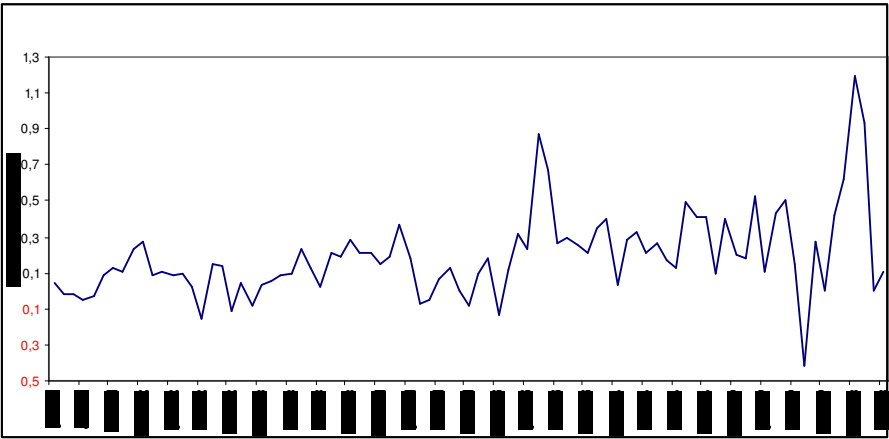
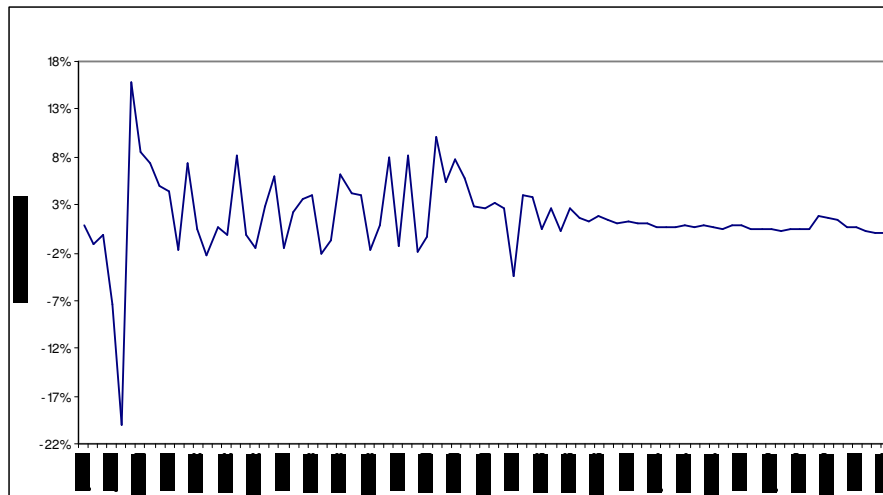


Fig. 2. Brazil, interest rate differential: a) measured by uncovered parity, b) measured by covered parity.

a)



b)

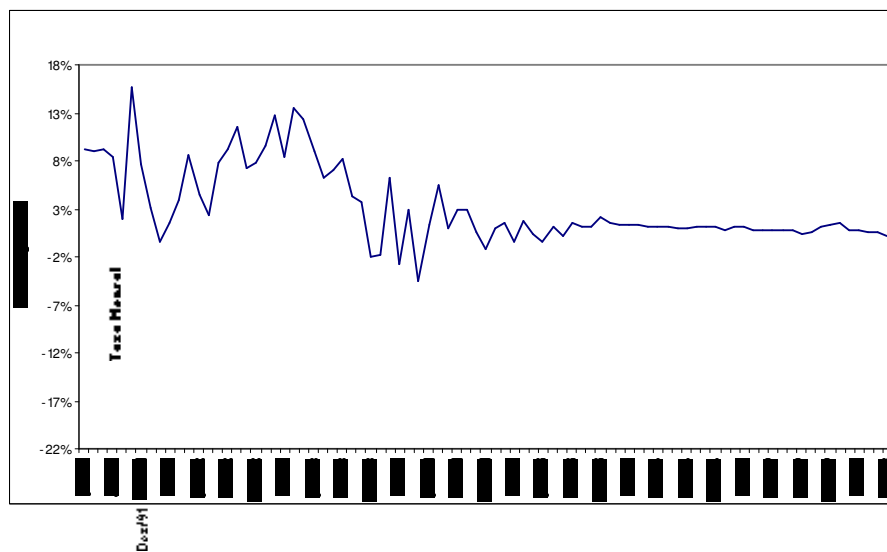
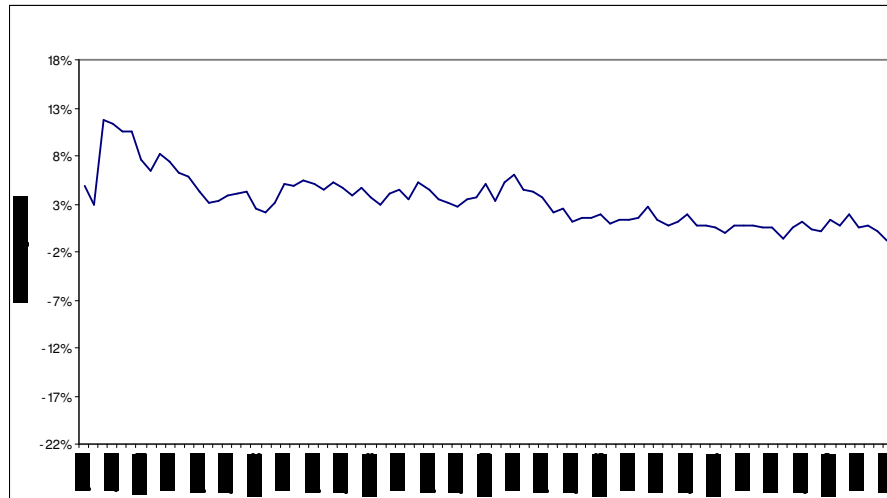


Fig. 3. Estimated interest rate differential (measured by uncovered parity): a) Heckman's technique, b) Lee's technique.

a)



b)

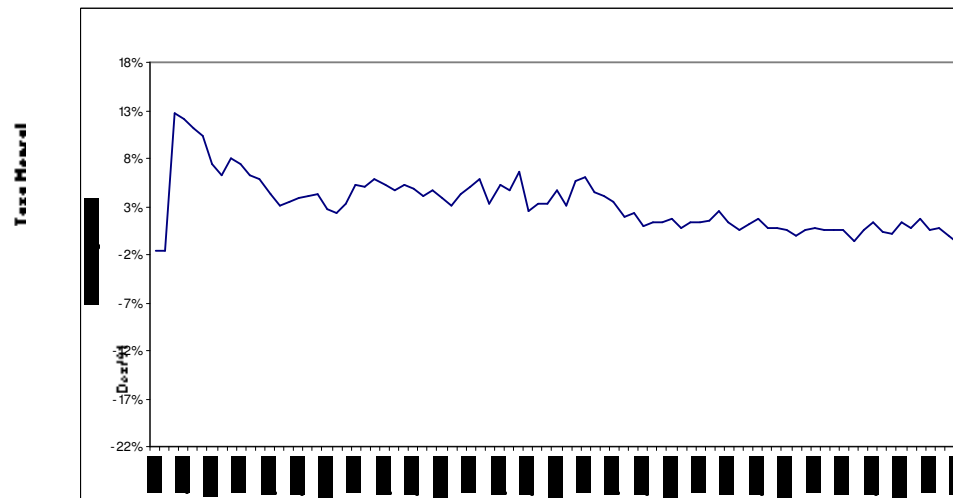


Fig. 4. Interest rate differential (measured by covered parity), estimated by Lee's technique.

